Remarks:

1. Claims 1 through 32 were original presented in the instant application. No claims have been added or canceled. Claims 1 through 32 remain pending.

2. Claims 1 through 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Gill et al.* (U.S. Patent 5,936,913) in view of *Cheng and Toksoz* (Determination of Shear Wave Velocities in Slow Formations). In particular, the Examiner states: "since both references are drawn to the same concepts and technology studies, it would have been obvious to one of ordinary skill in the art to incorporate into the *Gill et al.* system the specific data processing teaching of *Cheng et al.* to derive the shear wave velocity component from the borehole acoustic received signals."

3. The Applicant respectfully traverses this rejection. Applicant respectfully submits that, contrary to MPEP § 2143, the Examiner has failed to make a *prima facie* case of obviousness. As the Federal Circuit has held, "to establish obviousness based on a combination of the elements disclosed in the prior art, there must be some motivation, suggestion, or teaching of the desirability of making the specific combination that was made by the applicant." *In re Kotzab*, 271 F.3d 1365, 1370 (Fed. Cir. 2000). The Examiner "must provide particular findings" supporting a combination of prior art references. *Id.* Indeed, the Federal Circuit has emphasized the need for a "rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references." *In re Dembiczak*, 175 F.3d 994, 999 (Fed. Cir. 1999); *see also In re Fine*, 837 F.2d 1071, 1074-75 (Fed. Cir. 1988). As shown below, the Applicant believes that close examination of the disclosures of *Gill et al.* and *Cheng et al.*" in view of the instant claims and specification reveals that the combination of *Gill et al.* and *Cheng et al.* is not proper, nor is it applicable to the invention disclosed and recited in the instant application.

4. Moreover, close examination of *Gill et al.* reveals that in fact, their disclosure strongly teaches *away* from the Examiner's combination with *Cheng et al.* *Gill et al.* disclose an acoustic logging tool including "a tube wave absorber section between the

transmitter and receiver sections" (column 5, lines 49-50). The tube wave absorber disclosed in columns 18 and 19 of *Gill et al.* is a complex, 15-foot section including a plurality of resistive and capacitive elements which are configured to attenuate the propagation of tube waves (i.e., borehole guided waves). As stated by *Gill et al.*: "The tube wave absorber attenuates undesirable tube waves propagating in the drilling mud surrounding the tool, while allowing desirable waves in the formation to pass freely" (column 7, lines 11-14, emphasis added). In summary, *Gill et al.* clearly teach the undesirability of borehole guided waves, and accordingly disclose an elaborate mechanism for their attenuation. The disclosure of *Gill et al.* thus clearly teaches away from (and in fact is in direct contradiction of) that of *Cheng and Toksoz*, who teach the desirability and use of a Stoneley wave (a zeroeth order borehole guided wave) to determine shear wave velocity in acoustically slow formations.

5. For the foregoing reasons, the Applicant submits that the Examiner's obviousness combination of *Gill et al.* and *Cheng et al.* is improper. Applicant, therefore respectfully requests that the Examiner withdraw the above-cited rejection of claims 1 through 32.

6. Moreover, the combination of *Gill et al.* and *Cheng et al.* does not teach the Applicant's invention as recited in original, independent claims 1 and 32. Claim 1 recites "a method for determining a shear wave velocity of a subterranean formation, the method comprising... propagating a multi-pole acoustic signal in the borehole... and receiving an acoustic waveform from the multi-pole acoustic signal". The Applicant submits that *Gill et al.* do not use the term "multipole" in the same sense as it is used in the instant application. As used in the instant application:

> the term "multi-pole" refers to an acoustic signal including multiple azimuthal orders (i.e., multiple harmonics), in which no particular preselected azimuthal order (or combination thereof) has been designated for processing" (paragraph [0021], lines 3-5).

In sharp contrast, *Gill et al.*, use the term "multipole" to refer to any wave having more than one pole. In particular, *Gill et al.* state:

> "A monopole source provides a positive pressure pulse symmetric on all sides of the tool. Multipole sources generate asymmetric pressure waves around the tool; a dipole source provides positive pressure at one side and an equal negative pressure at the opposite side; a quadrupole source provides alternating positive and negative pulses at 90 degree intervals around the circumference of the tool. Higher multipoles, such as octopoles have also been considered" (column 3, lines 25-33).

Thus, even in combination, *Gill et al.* and *Cheng et al.* do not teach a method for determining a shear velocity of a subterranean formation utilizing a multi-pole acoustic signal as recited in independent claims 1 and 32 in the instant application. Accordingly, the Applicant submits that independent claims 1 and 32 are patentable in view of the cited prior art.

7. The Applicant further submits that for a third substantive reason, *Gill et al.* strongly teach away from the invention set forth in the instant application and recited in the pending claims. As noted above, the specification of the instant application discloses the use of multi-pole acoustic signals having multiple harmonics to determine the shear velocity of a subterranean formation. Paragraph [0022] of the instant specification states:

> "The use of multi-pole acoustic signals advantageously obviates the need to generate acoustic signals having a substantially pure or a "pseudo" azimuthal order, for example, substantially pure or pseudo dipole waves or substantially pure or pseudo quadrupole waves as utilized in the prior art. As described above [in the background section of the instant application], the utilization of acoustic signals having a substantially pure or pseudo azimuthal order typically requires transmitters and receivers having significantly increased complexity (and therefore cost). Rather, it will be appreciated that pursuant to this invention, it is not necessary to isolate, suppress or enhance any particular azimuthal (harmonic) modes in either transmission or reception of the ultrasonic energy (waveforms). The waveform may be taken as it is received. For example, activities such as filtering, interference, or adding or subtracting of various waveforms from one transmitter or receiver with that of another, are not required. Likewise, it is not necessary to deploy transmitters or receivers having a particular geometry, or to ordain the timing of various components to transmit or receive substantially pure or pseudo monopole, dipole, or quadrupole waveforms. Rather as stated above, this invention utilizes multi-pole waveforms including multiple (at least two) azimuthal orders. Thus, exemplary methods of this invention may enable acoustic logging tools having relatively simple, inexpensive transmitters and receivers to be utilized."

8. *Gill et al.*, on the other hand, is representative of the prior art discussed in the Background Section of the instant application in that they teach the use of highly complex transmitter and receiver elements to isolate and/or suppress various acoustic modes in both transmission and reception (e.g., monopole, x-dipole, y-dipole, and quadrupole modes as stated in column 5, lines 58-60 and column 6, lines 7-11). Regarding the acoustic transmitter *Gill et al.* state:

> "The interior volume of the transmitter section is subdivided into a multiplicity of transmitter assemblies... as shown in Fig 3, there are four transmitter assemblies stacked vertically within the interior volume of the transmitter section 26 including the following subsections: (1) a first monopole transmitter...; (2) a second or Y-dipole transmitter...; (3) a third X-dipole transmitter...; and (4) a fourth quadrupole transmitter..." (column 11, line 40 through column 12 line 2).

The acoustic transmitter disclosed by *Gill et al.* further includes various pulse diverters for enhancing and/or suppressing certain positive and negative pressure pulses. Regarding such pulse diverters, *Gill et al.* further state:

> Fig 4A, Fig. 4B, and Fig. 4C illustrate various pulse diverters for use with monopole, dipole, and quadrupole transmitters. As described above, the monopole pulse diverter 86 allows the positive pressure pulse 68 to exit only from exit holes 58A on oppose sides of the tool, and it also blocks the negative pulse (Fig. 4A)... As shown in Fig. 4B, the dipole pulse diverter 94 diverts the positive pressure pulse 68 to one side of the tool which exits through hole 58B and the negative pressure pulse 70 to the opposite side of the tool 10 which passes through hole 58C. The quadrupole pulse diverter 96 diverts the positive pulse 68 to two oppositely situated exit holes 58D and the negative pulse 70 to two oppositely situated exit holes 58E, as shown in Fig. 4C (column 12, line 64 through column 13, line 13).

Regarding the acoustic receiver, *Gill et al.* state:

> The receiver section is constructed from a thick-walled steel tube 154 containing a multiplicity of receiver assemblies 156. In the preferred embodiment, sixteen receiver assemblies are disposed as a sequence of four axially spaced apart receiver stations, each station having four receiver assemblies situated at 0 degree, 90 degree, 180 degree, and 270 degree azimuthal locations around the circumference of the tool (column 20, lines 3-10).

Gill et al. further state that the purpose of such a receiver arrangement is to "provide a selective response to monopole waves, dipole waves, quadrupole waves, and unipole waves

by processing information from all sides of the tool" (column 6, lines 8-11, emphasis added). *Gill et al.* go on to further state:

> "It is a further feature of this invention that the relative concentration of wave components is controlled by selecting a particular acoustic mode for transmitter and receiver; thus the monopole mode is typically selected for compression waves in an open hole, the dipole mode is typically selected for shear waves in an open hole, and the quadrupole mode is sometimes used for both shear and compression waves in a cased hole" (column 26, lines 12-19, emphasis added).

In summary, *Gill et al.* teach the use of highly complex transmitter and receiver arrangements to transmit and receive acoustic waves having substantially pure harmonic modes. Such teaching is in clear opposition to the instant invention as recited in independent claims 1, 22 and 32. Moreover, they do not teach, or even suggest, in any way the use of acoustic waves having multiple harmonics.

9. For the foregoing reasons, Applicant respectfully submits that independent claims 1, 22, and 32 as originally presented are allowable over the cited prior art. Applicant requests reconsideration and allowance of claims 1, 22, and 32. Independent claims 1 and 22 being allowable, it follows *a fortiori* that dependent claims 2 through 21 and 23 through 31 must also be allowable, since these dependent claims carry with them all the elements of the independent claims to which they ultimately refer.

10. Applicant has reviewed the art made of record by the Examiner but not applied to the claims, and believes that these references are less relevant and/or merely cumulative of the references that the Examiner has applied to the pending claims.

11. Applicant also draws the Examiner's attention to the Information Disclosure Statement filed with this paper. The references cited in this IDS were cited in a Search Report received in a United Kingdom counterpart application to the instant application. These references were received by Applicant after receipt of the Office Action to which this paper responds. Applicant believes that these references cited in the U.K. Search report are

also less relevant and/or merely cumulative of the references that the Examiner has applied to the pending claims.

Applicant believes that in view of the foregoing remarks, pending claims 1 through 32 are allowable, and that this application in now in full condition for allowance, which action Applicant earnestly solicits. Should the Examiner have any questions, or believe that a telephone interview may expedite the further examination of this application, the Examiner is requested to contact the undersigned at the telephone number shown below.

Respectfully submitted,

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